

Documentation for Multi-year (1997-2012) CAPT Hindcast Output

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Model

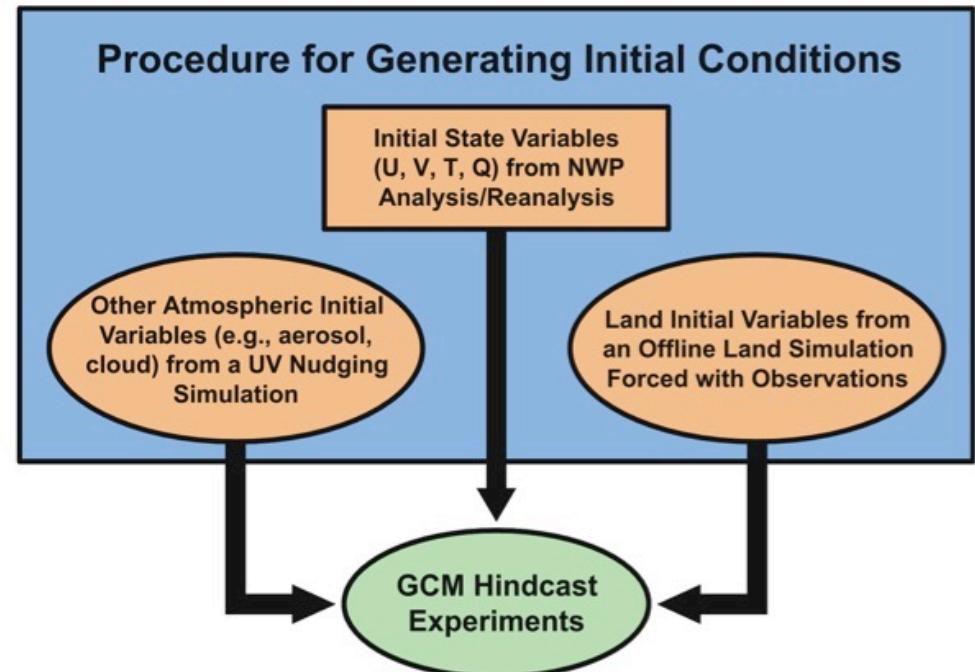
NSF/DOE CAM5 (version cesm1_0_5, FC5 compset, 0.9x1.25L30, Neale et al. 2012)

Experiment description

We performed 3-day long hindcasts starting at 00Z every day for the years of 1997 to 2012. We applied state variables (horizontal velocities, temperature and specific humidity) from the ERA-Interim Reanalysis (Dee et al. 2011) for the atmospheric initial states. Without a data assimilation system, we applied a two-step process (See figure to the right) to obtain other necessary variables to initialize both the atmospheric (e.g., aerosols and clouds) and land models (e.g., soil moisture). First, we nudged only the model horizontal velocities towards ERA-Interim Reanalysis values, given a 6-hour relaxation time scale, to obtain all necessary variables. Second, we obtain land initial conditions from an offline CLM simulation forced with observed precipitation, winds, and surface fluxes. The nudging and hindcast simulations were prescribed with NOAA Optimum Interpolation weekly SSTs and sea ice (Reynolds et al. 2002). The offline CLM simulation was forced with observed six-hourly atmospheric precipitation, winds and surface fluxes from N. Viovy (unpublished data, 2013) available

at

(<http://dods.ipsl.jussieu.fr/igcmg/IGCM/BC/OOL/OL/CRU-NCEP>) for years 1990 to 2012. More details about the initialization method is described in Ma et al. (2015).



Procedure to generate initial conditions for the multi-year hindcast experiment (Figure taken from Ma et al. 2015).

Data description:

The data is located over http://portal.nersc.gov/archive/home/h/hyma/www/CAPT/CAPT_Long/. All files are in **NetCDF** format.

The raw model history files are in **h0/, h1/, h2/, h3/, h4/, h5/, landh0/, landh1/** directories. Each hindcast file, (for example, h0/2009/CAPT_Interim_cam5.1.cam2.h0.2009-01-01-00000.nc), is 3-day long and the starting date is indicated by the file name (here the starting date is 00Z, Jan 01, 2009). The frequencies are different for different h tapes (see below Page 5- for individual h file frequency and variable information).

We also processed/concatenated the raw data into Day 2 (24h to 48h) and Day 3 (48h to 72h) daily and monthly mean fields. They are in the **Processed/Daily/** and **Processed/Monthly/** directories. Individual patch/site output of Day 2 and Day 3 time step data is over **Processed/Sites/**.

How to obtain the data:

All the data are downloaded from tapes, and therefore downloads may take minutes to start. To download single file, one can just click on the file link. The download should start shortly.

A recommended method to obtain multiple files is to generate a unix/linux shell script with "wget" command. For example to obtain cam2.h0 history files from Jan 01, 2009 to Jan 5, 2009, one can use the following commands in one single script file:

```
#####  
wget -O 'CAPT_Interim_cam5.1.cam2.2009-01-01-00000.nc' 'http://portal.nersc.gov/  
http://portal.nersc.gov/archive/home/h/hyma/www/CAPT/CAPT_Long/h0/2009/CAPT_Interim_cam5.1.cam2.2009-  
01-01-00000.nc'  
wget -O 'CAPT_Interim_cam5.1.cam2.2009-01-02-00000.nc' 'http://portal.nersc.gov/  
http://portal.nersc.gov/archive/home/h/hyma/www/CAPT/CAPT_Long/h0/2009/CAPT_Interim_cam5.1.cam2.2009-  
01-02-00000.nc'  
wget -O 'CAPT_Interim_cam5.1.cam2.2009-01-03-00000.nc' 'http://portal.nersc.gov/  
http://portal.nersc.gov/archive/home/h/hyma/www/CAPT/CAPT_Long/h0/2009/CAPT_Interim_cam5.1.cam2.2009-  
01-03-00000.nc'  
wget -O 'CAPT_Interim_cam5.1.cam2.2009-01-04-00000.nc' 'http://portal.nersc.gov/  
http://portal.nersc.gov/archive/home/h/hyma/www/CAPT/CAPT_Long/h0/2009/CAPT_Interim_cam5.1.cam2.2009-  
01-04-00000.nc'
```

```
wget -O 'CAPT_Interim_cam5.1.cam2.2009-01-05-00000.nc' 'http://portal.nersc.gov/  
http://portal.nersc.gov/archive/home/h/hyma/www/CAPT/CAPT_Long/h0/2009/CAPT_Interim_cam5.1.cam2.2009-  
01-05-00000.nc'
```

Above is just an example and one has to change the directory path (h0, year, date) to get the desired files.

References:

- Dee, D. P., and coauthors, 2011: The ERA-Interim reanalysis: Configuration and performance of the data assimilation system. *Quart. J. Roy. Meteor. Soc.*, **137**, 553–828.
- Ma, H.-Y., and coauthors, 2015: An improved hindcast approach for evaluation and diagnosis of physical processes in global climate models. *J. Adv. Model. Earth Syst.*, **07**, doi:10.1002/2015MS000490.
- Neale, R. and coauthors, 2012: Description of the NCAR Community Atmosphere Model (CAM5.0). NCAR Tech. Note NCAR-TN-486+STR, 274pp.
- Reynolds, R.W., N.A. Rayner, T.M. Smith, D.C. Stokes, and W. Wang, 2002: An improved in situ and satellite SST analysis for climate. *J. Climate*, **15**, 1609–1625.

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The following is the list of variables from the hindcasts. This list includes output variable names (in NetCDFs), frequencies, variable long names and units.

#CAM h0 (cam2.h0): Aerosol + default CAM5 variables (not listed here) daily mean

AODABS	A	1	absorption optical depth 550 nm
AODVIS	A	1	optical depth 550 nm
AREI	30	Micron	Average ice effective radius
AREL	30	Micron	Average droplet effective radius
CCN1	30	#/cm3	CCN concentration at S=0.02%
CCN2	30	#/cm3	CCN concentration at S=0.05%
CCN3	30	#/cm3	CCN concentration at S=0.1%
CCN4	30	#/cm3	CCN concentration at S=0.2%
CCN5	30	#/cm3	CCN concentration at S=0.5%
CCN6	30	#/cm3	CCN concentration at S=1.0%
DMS	30	kg/kg	DMS
FLNTC_d1	1	W/m2	Clearsky net longwave flux at top of model
FLNT_d1	1	W/m2	Net longwave flux at top of model
FSNTC_d1	1	W/m2	Clearsky net solar flux at top of model
FSNT_d1	1	W/m2	Net solar flux at top of model
H2O2	30	kg/kg	H2O2
H2SO4	30	kg/kg	H2SO4
PS	1	Pa	Surface pressure
SFbc_a1	1	kg/m2/s	bc_a1 surface flux
SFdst_a1	1	kg/m2/s	dst_a1 surface flux
SFdst_a3	1	kg/m2/s	dst_a3 surface flux
SFncl_a1	1	kg/m2/s	ncl_a1 surface flux
SFncl_a2	1	kg/m2/s	ncl_a2 surface flux
SFncl_a3	1	kg/m2/s	ncl_a3 surface flux
SFPom_a1	1	kg/m2/s	pom_a1 surface flux
SFSO4_a1	1	kg/m2/s	so4_a1 surface flux
SFSO4_a2	1	kg/m2/s	so4_a2 surface flux
SFSO4_a3	1	kg/m2/s	so4_a3 surface flux
SFSOA_a1	1	kg/m2/s	soa_a1 surface flux
SFSOA_a2	1	kg/m2/s	soa_a2 surface flux
SO2	30	kg/kg	SO2
SOAG	30	kg/kg	SOAG
TMDMS	1	kg/m2	DMS column burden
TMH2O2	1	kg/m2	H2O2 column burden
TMH2SO4	1	kg/m2	H2SO4 column burden

TMSO2	1	kg/m2	SO2 column burden
TMSOAG	1	kg/m2	SOAG column burden
TMbc_a1	1	kg/m2	bc_a1 column burden
TMdst_a1	1	kg/m2	dst_a1 column burden
TMdst_a3	1	kg/m2	dst_a3 column burden
TMncl_a1	1	kg/m2	ncl_a1 column burden
TMncl_a2	1	kg/m2	ncl_a2 column burden
TMncl_a3	1	kg/m2	ncl_a3 column burden
TMnum_a1	1	kg/m2	num_a1 column burden
TMnum_a2	1	kg/m2	num_a2 column burden
TMnum_a3	1	kg/m2	num_a3 column burden
TMpom_a1	1	kg/m2	pom_a1 column burden
TMso4_a1	1	kg/m2	so4_a1 column burden
TMso4_a2	1	kg/m2	so4_a2 column burden
TMso4_a3	1	kg/m2	so4_a3 column burden
TMsoa_a1	1	kg/m2	soa_a1 column burden
TMsoa_a2	1	kg/m2	soa_a2 column burden
bc_a1	30	kg/kg	bc_a1
bc_a1DDF	1	kg/m2/s	bc_a1 dry deposition flux at bottom (grav + turb)
bc_a1SFWET	1	kg/m2/s	Wet deposition flux at surface
bc_a1_CLXF	1	molec/cm2/s	vertically intergrated external forcing for bc_a1
bc_c1	30	kg/kg	bc_c1
bc_c1DDF	1	kg/m2/s	bc_c1 dry deposition flux at bottom (grav + turb)
bc_c1SFWET	1	kg/m2/s	bc_c1 wet deposition flux at surface
dgnd_a01	30	m	dry dgnum, interstitial, mode 01
dgnd_a02	30	m	dry dgnum, interstitial, mode 02
dgnd_a03	30	m	dry dgnum, interstitial, mode 03
dgnw_a01	30	m	wet dgnum, interstitial, mode 01
dgnw_a02	30	m	wet dgnum, interstitial, mode 02
dgnw_a03	30	m	wet dgnum, interstitial, mode 03
dst_a1	30	kg/kg	dst_a1
dst_a1DDF	1	kg/m2/s	dst_a1 dry deposition flux at bottom (grav + turb)
dst_a1SFWET	1	kg/m2/s	Wet deposition flux at surface
dst_a3	30	kg/kg	dst_a3
dst_a3DDF	1	kg/m2/s	dst_a3 dry deposition flux at bottom (grav + turb)
dst_a3SFWET	1	kg/m2/s	Wet deposition flux at surface
dst_c1	30	kg/kg	dst_c1
dst_c1DDF	1	kg/m2/s	dst_c1 dry deposition flux at bottom (grav + turb)

dst_c1FWET	1	kg/m ² /s	dst_c1 wet deposition flux at surface
dst_c3	30	kg/kg	dst_c3
dst_c3DDF	1	kg/m ² /s	dst_c3 dry deposition flux at bottom (grav + turb)
dst_c3FWET	1	kg/m ² /s	dst_c3 wet deposition flux at surface
ncl_a1	30	kg/kg	ncl_a1
ncl_a1DDF	1	kg/m ² /s	ncl_a1 dry deposition flux at bottom (grav + turb)
ncl_a1FWET	1	kg/m ² /s	Wet deposition flux at surface
ncl_a2	30	kg/kg	ncl_a2
ncl_a2DDF	1	kg/m ² /s	ncl_a2 dry deposition flux at bottom (grav + turb)
ncl_a2FWET	1	kg/m ² /s	Wet deposition flux at surface
ncl_a3	30	kg/kg	ncl_a3
ncl_a3DDF	1	kg/m ² /s	ncl_a3 dry deposition flux at bottom (grav + turb)
ncl_a3FWET	1	kg/m ² /s	Wet deposition flux at surface
ncl_c1	30	kg/kg	ncl_c1
ncl_c1DDF	1	kg/m ² /s	ncl_c1 dry deposition flux at bottom (grav + turb)
ncl_c1FWET	1	kg/m ² /s	ncl_c1 wet deposition flux at surface
ncl_c2	30	kg/kg	ncl_c2
ncl_c2DDF	1	kg/m ² /s	ncl_c2 dry deposition flux at bottom (grav + turb)
ncl_c2FWET	1	kg/m ² /s	ncl_c2 wet deposition flux at surface
ncl_c3	30	kg/kg	ncl_c3
ncl_c3DDF	1	kg/m ² /s	ncl_c3 dry deposition flux at bottom (grav + turb)
ncl_c3FWET	1	kg/m ² /s	ncl_c3 wet deposition flux at surface
num_a1	30	kg/kg	num_a1
num_a2	30	kg/kg	num_a2
num_a3	30	kg/kg	num_a3
pom_a1	30	kg/kg	pom_a1
pom_a1DDF	1	kg/m ² /s	pom_a1 dry deposition flux at bottom (grav + turb)
pom_a1FWET	1	kg/m ² /s	Wet deposition flux at surface
pom_a1_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for pom_a1
pom_c1	30	kg/kg	pom_c1
pom_c1DDF	1	kg/m ² /s	pom_c1 dry deposition flux at bottom (grav + turb)
pom_c1FWET	1	kg/m ² /s	pom_c1 wet deposition flux at surface
so4_a1	30	kg/kg	so4_a1
so4_a1DDF	1	kg/m ² /s	so4_a1 dry deposition flux at bottom (grav + turb)
so4_a1FWET	1	kg/m ² /s	Wet deposition flux at surface
so4_a1_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for so4_a1
so4_a1_sfgaex1	1	kg/m ² /s	so4_a1 gas-aerosol-exchange primary column tendency
so4_a2	30	kg/kg	so4_a2

so4_a2DDF	1	kg/m ² /s	so4_a2 dry deposition flux at bottom (grav + turb)
so4_a2SFWET	1	kg/m ² /s	Wet deposition flux at surface
so4_a2_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for so4_a2
so4_a2_sfgaex1	1	kg/m ² /s	so4_a2 gas-aerosol-exchange primary column tendency
so4_a2_sfnnuc1	1	kg/m ² /s	so4_a2 modal_aero new particle nucleation column tendency
so4_a3	30	kg/kg	so4_a3
so4_a3DDF	1	kg/m ² /s	so4_a3 dry deposition flux at bottom (grav + turb)
so4_a3SFWET	1	kg/m ² /s	Wet deposition flux at surface
so4_a3_sfgaex1	1	kg/m ² /s	so4_a3 gas-aerosol-exchange primary column tendency
so4_c1	30	kg/kg	so4_c1
so4_c1AQH2SO4	1	kg/m ² /s	so4_c1 aqueous phase chemistry
so4_c1AQSO4	1	kg/m ² /s	so4_c1 aqueous phase chemistry
so4_c1DDF	1	kg/m ² /s	so4_c1 dry deposition flux at bottom (grav + turb)
so4_c1SFWET	1	kg/m ² /s	so4_c1 wet deposition flux at surface
so4_c2	30	kg/kg	so4_c2
so4_c2AQH2SO4	1	kg/m ² /s	so4_c2 aqueous phase chemistry
so4_c2AQSO4	1	kg/m ² /s	so4_c2 aqueous phase chemistry
so4_c2DDF	1	kg/m ² /s	so4_c2 dry deposition flux at bottom (grav + turb)
so4_c2SFWET	1	kg/m ² /s	so4_c2 wet deposition flux at surface
so4_c3	30	kg/kg	so4_c3
so4_c3AQH2SO4	1	kg/m ² /s	so4_c3 aqueous phase chemistry
so4_c3AQSO4	1	kg/m ² /s	so4_c3 aqueous phase chemistry
so4_c3DDF	1	kg/m ² /s	so4_c3 dry deposition flux at bottom (grav + turb)
so4_c3SFWET	1	kg/m ² /s	so4_c3 wet deposition flux at surface
soa_a1	30	kg/kg	soa_a1
soa_a1DDF	1	kg/m ² /s	soa_a1 dry deposition flux at bottom (grav + turb)
soa_a1SFWET	1	kg/m ² /s	Wet deposition flux at surface
soa_a1_sfgaex1	1	kg/m ² /s	soa_a1 gas-aerosol-exchange primary column tendency
soa_a2	30	kg/kg	soa_a2
soa_a2DDF	1	kg/m ² /s	soa_a2 dry deposition flux at bottom (grav + turb)
soa_a2SFWET	1	kg/m ² /s	Wet deposition flux at surface
soa_a2_sfgaex1	1	kg/m ² /s	soa_a2 gas-aerosol-exchange primary column tendency
soa_c1	30	kg/kg	soa_c1
soa_c1DDF	1	kg/m ² /s	soa_c1 dry deposition flux at bottom (grav + turb)
soa_c1SFWET	1	kg/m ² /s	soa_c1 wet deposition flux at surface
soa_c2	30	kg/kg	soa_c2
soa_c2DDF	1	kg/m ² /s	soa_c2 dry deposition flux at bottom (grav + turb)
soa_c2SFWET	1	kg/m ² /s	soa_c2 wet deposition flux at surface

#CAM h1 (cam2.h1): Simulator 3hrly mean

CLDHGH_CAL	1	percent	Lidar High-level Cloud Fraction
CLDLow_CAL	1	percent	Lidar Low-level Cloud Fraction
CLDMED_CAL	1	percent	Lidar Mid-level Cloud Fraction
CLDTOT_CAL	1	percent	Lidar Total Cloud Fraction
CLDTOT_ISCCP	1	percent	Total Cloud Fraction Calculated by the ISCCP Simulator
CLD_CAL	40	percent	Lidar Cloud Fraction (532 nm)
CLD_CAL_NOTCS	40	percent	Cloud occurrence seen by CALIPSO but not CloudSat
CLHMODIS	1	%	MODIS High Level Cloud Fraction
CLIMODIS	1	%	MODIS Ice Cloud Fraction
CLLMODIS	1	%	MODIS Low Level Cloud Fraction
CLMMODIS	1	%	MODIS Mid Level Cloud Fraction
CLMODIS	42	%	MODIS Cloud Area Fraction
CLTMODIS	1	%	MODIS Total Cloud Fraction
CLWMODIS	1	%	MODIS Liquid Cloud Fraction
FISCCP1_COSP	49	percent	Grid-box fraction covered by each ISCCP D level cloud type
IWPMODIS	m-2	kg	A MODIS Cloud Ice Water Path*CLIMODIS
LWPMODIS	m-2	kg	A MODIS Cloud Liquid Water Path*CLWMODIS
MEANCLDALB_ISCCP	1	1	Mean cloud albedo*CLDTOT_ISCCP
MEANPTOP_ISCCP	1	Pa	Mean cloud top pressure*CLDTOT_ISCCP
MEANTAU_ISCCP	1	1	Mean optical thickness*CLDTOT_ISCCP
MEANTBCLR_ISCCP	1	K	Mean Clear-sky Infrared Tb from ISCCP simulator
MEANTB_ISCCP	1	K	Mean Infrared Tb from ISCCP simulator
PCTMODIS	1	Pa	MODIS Cloud Top Pressure*CLTMODIS
PS	1	Pa	Surface pressure
REFFCLIMODIS	1	m	MODIS Ice Cloud Particle Size*CLIMODIS
REFFCLWMODIS	1	m	MODIS Liquid Cloud Particle Size*CLWMODIS
RFL_PARASOL	5	fraction	PARASOL-like mono-directional reflectance
TAUILOGMODIS	1	1	MODIS Ice Cloud Optical Thickness (Log10 Mean)*CLIMODIS
TAUIMODIS	1	1	MODIS Ice Cloud Optical Thickness*CLIMODIS
TAUTLOGMODIS	1	1	MODIS Total Cloud Optical Thickness (Log10 Mean) *CLTMODIS
TAUTMODIS	1	1	MODIS Total Cloud Optical Thickness*CLTMODIS
TAUWLOGMODIS	1	1	MODIS Liquid Cloud Optical Thickness (Log10 Mean) *CLWMODIS
TAUWMODIS	1	1	MODIS Liquid Cloud Optical Thickness*CLWMODIS

#CAM h2 (cam2.h2): global budget terms 3hrly mean			
CMFDQ	30	kg/kg/s	QV tendency - shallow convection
CMFDT	30	K/s	T tendency - shallow convection
DCQ	30	kg/kg/s	Q tendency due to moist processes
DMEQ	30	kg/kg/s	Q dme adjustment tendency (FV)
DPDLFT	30	K/s	T tendency due to deep convective detrainment
DTCOND	30	K/s	T tendency - moist processes
DTV	30	K/s	T vertical diffusion
EVAPQZM	30	kg/kg/s	Q tendency - Evaporation from Zhang-McFarlane moist convection
EVAPTZM	30	K/s	T tendency - Evaporation/snow prod from Zhang convection
MACPDQ	30	kg/kg/s	Q tendency - Revised macrophysics
MACPDT	30	W/kg	Heating tendency - Revised macrophysics
MPDQ	30	kg/kg/s	Q tendency - Morrison microphysics
MPDT	30	W/kg	Heating tendency - Morrison microphysics
PS	1	Pa	Surface pressure
QAP	30	kg/kg	Specific humidity (after physics)
QRL	30	K/s	Longwave heating rate
QRS	30	K/s	Longwave heating rate
SHDLFT	30	K/s	T-tendency due to shallow convective detrainment
TAP	30	K	Temperature (after physics)
TFIX	1	K/s	T fixer (T equivalent of Energy correction)
TTGWORO	30	K/s	T tendency - orographic gravity wave drag
UAP	30	m/s	Zonal wind (after physics)
VAP	30	m/s	Meridional wind (after physics)
VD01	30	kg/kg/s	Vertical diffusion of Q
ZMDQ	30	kg/kg/s	Q tendency - Zhang-McFarlane moist convection
ZMDT	30	K/s	T tendency - Zhang-McFarlane moist convection
ZMMTT	30	K/s	T tendency - ZM convective momentum transport

Quick note for T & Q budgets:

$[Total_T_TEND_FV] = [Dyn_T_TEND_FV] + PTTEND + TFIX$
 $[Total_T_TEND_FV] = (TAP(n) - TAP(n-1)) / (time(n) - time(n-1))$
 $PTTEND = DTCOND + QRS + QRL + DTV + TTGWORO$

$[Total_Q_TEND_FV] = [Dyn_Q_TEND_FV] + PTEQ$
 $[Total_Q_TEND_FV] = (QAP(n) - QAP(n-1)) / (time(n) - time(n-1))$
 $PTEQ = DCQ + VD01 + DMEQ$

#CAM h3 (cam2.h3) : sites (patch output) 0.5hrly/time step

AODABS	A	1	absorption optical depth 550 nm
AODVIS	A	1	optical depth 550 nm
AREI	30	Micron	Average ice effective radius
AREL	30	Micron	Average droplet effective radius
AWNC	30	m-3	Average cloud water number conc
AWN1	30	m-3	Average cloud ice number conc
CAPE	1	J/kg	Convectively available potential energy
CCN1	30	#/cm3	CCN concentration at S=0.02%
CCN2	30	#/cm3	CCN concentration at S=0.05%
CCN3	30	#/cm3	CCN concentration at S=0.1%
CCN4	30	#/cm3	CCN concentration at S=0.2%
CCN5	30	#/cm3	CCN concentration at S=0.5%
CCN6	30	#/cm3	CCN concentration at S=1.0%
CDNUMC	1	#/m2	Vertically-integrated droplet concentration
CIN	1	J/kg	Convective inhibition
CLDHGH	1	fraction	Vertically-integrated high cloud
CLDICE	30	kg/kg	Grid box averaged cloud ice amount
CLDLIQ	30	kg/kg	Grid box averaged cloud liquid amount
CLDLLOW	1	fraction	Vertically-integrated low cloud
CLDMED	1	fraction	Vertically-integrated mid-level cloud
CLDTOT	1	fraction	Vertically-integrated total cloud
CLOUD	30	fraction	Cloud fraction
CMFDQ	30	kg/kg/s	QV tendency - shallow convection
CMFDT	30	K/s	T tendency - shallow convection
CMFMC	31	kg/m2/s	Convection mass flux (deep + shallow)
CMFMCDZM	31	kg/m2/s	Convection mass flux from ZM deep
CONCLD	30	fraction	Convective cloud cover
DCQ	30	kg/kg/s	Q tendency due to moist processes
DMEQ	30	kg/kg/s	Q dme adjustment tendency (FV)
DMS	30	kg/kg	DMS
DPDLFT	30	K/s	T tendency due to deep convective detrainment
DTCOND	30	K/s	T tendency - moist processes
DTV	30	K/s	T vertical diffusion
EMIS	1	1	Cloud longwave emissivity
EVAPQZM	30	kg/kg/s	Q tendency - Evaporation from Zhang-McFarlane moist convection
EVAPTZM	30	K/s	T tendency - Evaporation/snow prod from Zhang convection
FDL	31	W/m2	Longwave downward flux

FDLC	31	W/m2	Longwave clear-sky downward flux
FDS	31	W/m2	Shortwave downward flux
FDSC	31	W/m2	Shortwave clear-sky downward flux
FLDS	1	W/m2	Downwelling longwave flux at surface
FLDSC	1	W/m2	Clearsky Downwelling longwave flux at surface
FLNS	1	W/m2	Net longwave flux at surface
FLNSC	1	W/m2	Clearsky net longwave flux at surface
FLNTC_d1	1	W/m2	Clearsky net longwave flux at top of model
FLNT_d1	1	W/m2	Net longwave flux at top of model
FLUT	1	W/m2	Upwelling longwave flux at top of model
FLUTC	1	W/m2	Clearsky upwelling longwave flux at top of model
FSDS	1	W/m2	Downwelling solar flux at surface
FSDSC	1	W/m2	Clearsky downwelling solar flux at surface
FSNS	1	W/m2	Net solar flux at surface
FSNSC	1	W/m2	Clearsky net solar flux at surface
FSNT	1	W/m2	Net solar flux at top of model
FSNTC	1	W/m2	Clearsky net solar flux at top of model
FSNTC_d1	1	W/m2	Clearsky net solar flux at top of model
FSNT_d1	1	W/m2	Net solar flux at top of model
FUL	31	W/m2	Longwave upward flux
FULC	31	W/m2	Longwave clear-sky upward flux
FUS	31	W/m2	Shortwave upward flux
FUSC	31	W/m2	Shortwave clear-sky upward flux
GCLDLWP	30	kg/m2	Grid-box cloud water path
H2O2	30	kg/kg	H2O2
H2SO4	30	kg/kg	H2SO4
ICECLDF	30	fraction	Stratus ICE cloud fraction
ICEFRAC	1	fraction	Fraction of sfc area covered by sea-ice
ICIMR	30	kg/kg	Prognostic in-cloud ice mixing ratio
ICLDIWP	30	kg/m2	In-cloud ice water path
ICLDTWP	30	kg/m2	In-cloud cloud total water path (liquid and ice)
ICWMR	30	kg/kg	Prognostic in-cloud water mixing ratio
LHFLX	1	W/m2	Surface latent heat flux
LIQCLDF	30	fraction	Stratus Liquid cloud fraction
LS_FLXPRC	31	kg/m2/s	ls stratiform gbm interface rain+snow flux
LS_FLXSNW	31	kg/m2/s	ls stratiform gbm interface snow flux
LWCF	1	W/m2	Longwave cloud forcing
LWSH	1	m	Liquid water scale height

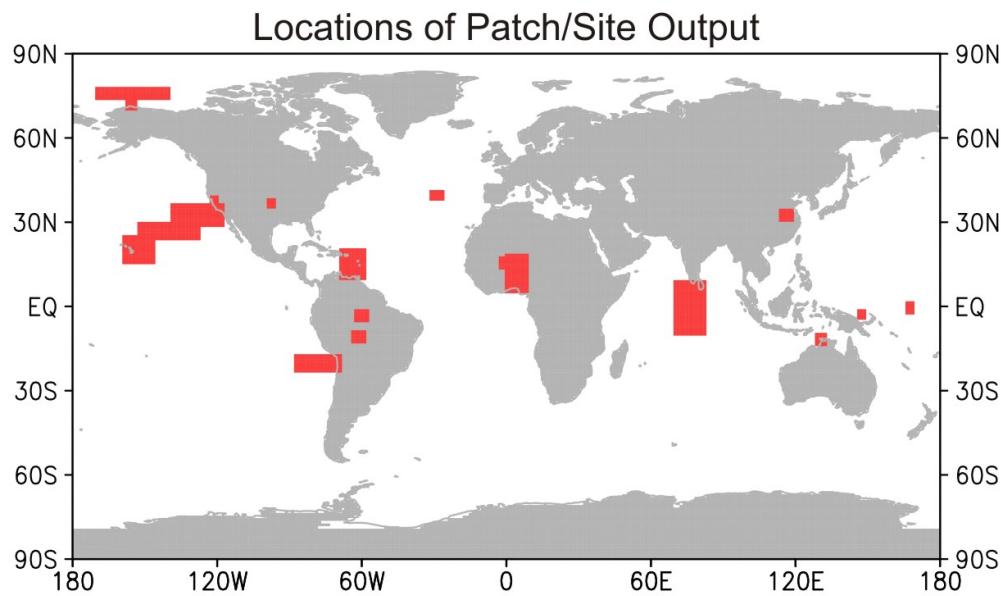
MACPDQ	30	kg/kg/s	Q tendency - Revised macrophysics
MACPDT	30	W/kg	Heating tendency - Revised macrophysics
MPDQ	30	kg/kg/s	Q tendency - Morrison microphysics
MPDT	30	W/kg	Heating tendency - Morrison microphysics
OMEGA	30	Pa/s	Vertical velocity (pressure)
PBLH	1	m	PBL height
PRECC	1	m/s	Convective precipitation rate (liq + ice)
PRECCDZM	1	m/s	Convective precipitation rate from ZM deep
PRECL	1	m/s	Large-scale (stable) precipitation rate (liq + ice)
PRECSC	1	m/s	Convective snow rate (water equivalent)
PRECSH	1	m/s	Shallow Convection precipitation rate
PRECSL	1	m/s	Large-scale (stable) snow rate (water equivalent)
PRECT	1	m/s	Total precipitation rate (liq + ice) (instantaneous values)
PS	1	Pa	Surface pressure
PSL	1	Pa	Sea level pressure
Q	30	kg/kg	Specific humidity
QAP	30	kg/kg	Specific humidity (after physics)
QRAIN	30	kg/kg	Diagnostic grid-mean rain mixing ratio
QREFHT	1	kg/kg	Reference height humidity
QRL	30	K/s	Longwave heating rate
QRS	30	K/s	Longwave heating rate
QSNOW	30	kg/kg	Diagnostic grid-mean snow mixing ratio
REI	30	micron	MG REI stratiform cloud effective radius ice
REL	30	micron	MG REL stratiform cloud effective radius liquid
RELHUM	30	percent	Relative humidity
RHREFHT	1	fraction	Reference height relative humidity
SETLWP	30	gram/m2	Prescribed liquid water path
SFbc_a1	1	kg/m2/s	bc_a1 surface flux
SFdst_a1	1	kg/m2/s	dst_a1 surface flux
SFdst_a3	1	kg/m2/s	dst_a3 surface flux
SFncl_a1	1	kg/m2/s	ncl_a1 surface flux
SFncl_a2	1	kg/m2/s	ncl_a2 surface flux
SFncl_a3	1	kg/m2/s	ncl_a3 surface flux
SFpom_a1	1	kg/m2/s	pom_a1 surface flux
SFso4_a1	1	kg/m2/s	so4_a1 surface flux
SFso4_a2	1	kg/m2/s	so4_a2 surface flux
SFso4_a3	1	kg/m2/s	so4_a3 surface flux
SFsoa_a1	1	kg/m2/s	soa_a1 surface flux

SFsoa_a2	1	kg/m2/s	soa_a2 surface flux
SHDLFT	30	K/s	T-tendency due to shallow convective detrainment
SHFLX	1	W/m2	Surface sensible heat flux
SO2	30	kg/kg	SO2
SOAG	30	kg/kg	SOAG
SOLIN	1	W/m2	Solar insolation
SWCF	1	W/m2	Shortwave cloud forcing
T	30	K	Temperature
TAP	30	K	Temperature (after physics)
TFIX	1	K/s	T fixer (T equivalent of Energy correction)
TGCLDCWP	1	kg/m2	Total grid-box cloud water path (liquid and ice)
TGCLDIWP	1	kg/m2	Total grid-box cloud ice water path
TGCLDLWP	1	kg/m2	Total grid-box cloud liquid water path
TMDMS	1	kg/m2	DMS column burden
TMH2O2	1	kg/m2	H2O2 column burden
TMH2SO4	1	kg/m2	H2SO4 column burden
TMSO2	1	kg/m2	SO2 column burden
TMSOAG	1	kg/m2	SOAG column burden
TMQ	1	kg/m2	Total (vertically integrated) precipitable water
TMbc_a1	1	kg/m2	bc_a1 column burden
TMdst_a1	1	kg/m2	dst_a1 column burden
TMdst_a3	1	kg/m2	dst_a3 column burden
TMncl_a1	1	kg/m2	ncl_a1 column burden
TMncl_a2	1	kg/m2	ncl_a2 column burden
TMncl_a3	1	kg/m2	ncl_a3 column burden
TMnum_a1	1	kg/m2	num_a1 column burden
TMnum_a2	1	kg/m2	num_a2 column burden
TMnum_a3	1	kg/m2	num_a3 column burden
TMpom_a1	1	kg/m2	pom_a1 column burden
TMso4_a1	1	kg/m2	so4_a1 column burden
TMso4_a2	1	kg/m2	so4_a2 column burden
TMso4_a3	1	kg/m2	so4_a3 column burden
TMsoa_a1	1	kg/m2	soa_a1 column burden
TMsoa_a2	1	kg/m2	soa_a2 column burden
TREFHT	1	K	Reference height temperature
TS	1	K	Surface temperature (radiative)
TTGWORO	30	K/s	T tendency - orographic gravity wave drag
U	30	m/s	Zonal wind

UAP	30	m/s	Zonal wind (after physics)
UBOT	1	m/s	Lowest model level zonal wind
UWFLXPRC	31	kg/m ² /s	Flux of precipitation from UW shallow convection
UWFLXSNW	31	kg/m ² /s	Flux of snow from UW shallow convection
V	30	m/s	Meridional wind
VAP	30	m/s	Meridional wind (after physics)
VBOT	1	m/s	Lowest model level meridional wind
VD01	30	kg/kg/s	Vertical diffusion of Q
Z3	30	m	Geopotential Height (above sea level)
ZMDQ	30	kg/kg/s	Q tendency - Zhang-McFarlane moist convection
ZMDT	30	K/s	T tendency - Zhang-McFarlane moist convection
ZMFLXPRC	31	kg/m ² /s	Flux of precipitation from ZM convection
ZMFLXSNW	31	kg/m ² /s	Flux of snow from ZM convection
ZMMTT	30	K/s	T tendency - ZM convective momentum transport
bc_a1	30	kg/kg	bc_a1
bc_a1DDF	1	kg/m ² /s	bc_a1 dry deposition flux at bottom (grav + turb)
bc_a1SFWET	1	kg/m ² /s	Wet deposition flux at surface
bc_a1_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for bc_a1
bc_c1	30	kg/kg	bc_c1
bc_c1DDF	1	kg/m ² /s	bc_c1 dry deposition flux at bottom (grav + turb)
bc_c1SFWET	1	kg/m ² /s	bc_c1 wet deposition flux at surface
dgnnd_a01	30	m	dry dgnnd, interstitial, mode 01
dgnnd_a02	30	m	dry dgnnd, interstitial, mode 02
dgnnd_a03	30	m	dry dgnnd, interstitial, mode 03
dgnw_a01	30	m	wet dgnnd, interstitial, mode 01
dgnw_a02	30	m	wet dgnnd, interstitial, mode 02
dgnw_a03	30	m	wet dgnnd, interstitial, mode 03
dst_a1	30	kg/kg	dst_a1
dst_a1DDF	1	kg/m ² /s	dst_a1 dry deposition flux at bottom (grav + turb)
dst_a1SFWET	1	kg/m ² /s	Wet deposition flux at surface
dst_a3	30	kg/kg	dst_a3
dst_a3DDF	1	kg/m ² /s	dst_a3 dry deposition flux at bottom (grav + turb)
dst_a3SFWET	1	kg/m ² /s	Wet deposition flux at surface
dst_c1	30	kg/kg	dst_c1
dst_c1DDF	1	kg/m ² /s	dst_c1 dry deposition flux at bottom (grav + turb)
dst_c1SFWET	1	kg/m ² /s	dst_c1 wet deposition flux at surface
dst_c3	30	kg/kg	dst_c3
dst_c3DDF	1	kg/m ² /s	dst_c3 dry deposition flux at bottom (grav + turb)

dst_c3FWET	1	kg/m ² /s	dst_c3 wet deposition flux at surface
ncl_a1	30	kg/kg	ncl_a1
ncl_a1DDF	1	kg/m ² /s	ncl_a1 dry deposition flux at bottom (grav + turb)
ncl_a1SFWET	1	kg/m ² /s	Wet deposition flux at surface
ncl_a2	30	kg/kg	ncl_a2
ncl_a2DDF	1	kg/m ² /s	ncl_a2 dry deposition flux at bottom (grav + turb)
ncl_a2SFWET	1	kg/m ² /s	Wet deposition flux at surface
ncl_a3	30	kg/kg	ncl_a3
ncl_a3DDF	1	kg/m ² /s	ncl_a3 dry deposition flux at bottom (grav + turb)
ncl_a3SFWET	1	kg/m ² /s	Wet deposition flux at surface
ncl_c1	30	kg/kg	ncl_c1
ncl_c1DDF	1	kg/m ² /s	ncl_c1 dry deposition flux at bottom (grav + turb)
ncl_c1SFWET	1	kg/m ² /s	ncl_c1 wet deposition flux at surface
ncl_c2	30	kg/kg	ncl_c2
ncl_c2DDF	1	kg/m ² /s	ncl_c2 dry deposition flux at bottom (grav + turb)
ncl_c2SFWET	1	kg/m ² /s	ncl_c2 wet deposition flux at surface
ncl_c3	30	kg/kg	ncl_c3
ncl_c3DDF	1	kg/m ² /s	ncl_c3 dry deposition flux at bottom (grav + turb)
ncl_c3SFWET	1	kg/m ² /s	ncl_c3 wet deposition flux at surface
num_a1	30	kg/kg	num_a1
num_a2	30	kg/kg	num_a2
num_a3	30	kg/kg	num_a3
ozone	30	mol/mol	prescribed ozone
pom_a1	30	kg/kg	pom_a1
pom_a1DDF	1	kg/m ² /s	pom_a1 dry deposition flux at bottom (grav + turb)
pom_a1SFWET	1	kg/m ² /s	Wet deposition flux at surface
pom_a1_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for pom_a1
pom_c1	30	kg/kg	pom_c1
pom_c1DDF	1	kg/m ² /s	pom_c1 dry deposition flux at bottom (grav + turb)
pom_c1SFWET	1	kg/m ² /s	pom_c1 wet deposition flux at surface
so4_a1	30	kg/kg	so4_a1
so4_a1DDF	1	kg/m ² /s	so4_a1 dry deposition flux at bottom (grav + turb)
so4_a1SFWET	1	kg/m ² /s	Wet deposition flux at surface
so4_a1_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for so4_a1
so4_a1_sfgaex1	1	kg/m ² /s	so4_a1 gas-aerosol-exchange primary column tendency
so4_a2	30	kg/kg	so4_a2
so4_a2DDF	1	kg/m ² /s	so4_a2 dry deposition flux at bottom (grav + turb)
so4_a2SFWET	1	kg/m ² /s	Wet deposition flux at surface

so4_a2_CLXF	1	molec/cm ² /s	vertically intergrated external forcing for so4_a2
so4_a2_sfgaex1	1	kg/m ² /s	so4_a2 gas-aerosol-exchange primary column tendency
so4_a2_sfnnucl	1	kg/m ² /s	so4_a2 modal_aero new particle nucleation column tendency
so4_a3	30	kg/kg	so4_a3
so4_a3DDF	1	kg/m ² /s	so4_a3 dry deposition flux at bottom (grav + turb)
so4_a3FWET	1	kg/m ² /s	Wet deposition flux at surface
so4_a3_sfgaex1	1	kg/m ² /s	so4_a3 gas-aerosol-exchange primary column tendency
so4_c1	30	kg/kg	so4_c1
so4_c1AQH2SO4	1	kg/m ² /s	so4_c1 aqueous phase chemistry
so4_c1AQSO4	1	kg/m ² /s	so4_c1 aqueous phase chemistry
so4_c1DDF	1	kg/m ² /s	so4_c1 dry deposition flux at bottom (grav + turb)
so4_c1FWET	1	kg/m ² /s	so4_c1 wet deposition flux at surface
so4_c2	30	kg/kg	so4_c2
so4_c2AQH2SO4	1	kg/m ² /s	so4_c2 aqueous phase chemistry
so4_c2AQSO4	1	kg/m ² /s	so4_c2 aqueous phase chemistry
so4_c2DDF	1	kg/m ² /s	so4_c2 dry deposition flux at bottom (grav + turb)
so4_c2FWET	1	kg/m ² /s	so4_c2 wet deposition flux at surface
so4_c3	30	kg/kg	so4_c3
so4_c3AQH2SO4	1	kg/m ² /s	so4_c3 aqueous phase chemistry
so4_c3AQSO4	1	kg/m ² /s	so4_c3 aqueous phase chemistry
so4_c3DDF	1	kg/m ² /s	so4_c3 dry deposition flux at bottom (grav + turb)
so4_c3FWET	1	kg/m ² /s	so4_c3 wet deposition flux at surface
soa_a1	30	kg/kg	soa_a1
soa_a1DDF	1	kg/m ² /s	soa_a1 dry deposition flux at bottom (grav + turb)
soa_a1FWET	1	kg/m ² /s	Wet deposition flux at surface
soa_a1_sfgaex1	1	kg/m ² /s	soa_a1 gas-aerosol-exchange primary column tendency
soa_a2	30	kg/kg	soa_a2
soa_a2DDF	1	kg/m ² /s	soa_a2 dry deposition flux at bottom (grav + turb)
soa_a2FWET	1	kg/m ² /s	Wet deposition flux at surface
soa_a2_sfgaex1	1	kg/m ² /s	soa_a2 gas-aerosol-exchange primary column tendency
soa_c1	30	kg/kg	soa_c1
soa_c1DDF	1	kg/m ² /s	soa_c1 dry deposition flux at bottom (grav + turb)
soa_c1FWET	1	kg/m ² /s	soa_c1 wet deposition flux at surface
soa_c2	30	kg/kg	soa_c2
soa_c2DDF	1	kg/m ² /s	soa_c2 dry deposition flux at bottom (grav + turb)
soa_c2FWET	1	kg/m ² /s	soa_c2 wet deposition flux at surface



Locations	Longitude	Latitude	grids
1.Niamey1	357E-359E	14N-17N	10
2.Niamey2	0-9E	5N-18N	120
3.DYNAMO	70E-83E	10S-9N	231
4.China-Shouxian	114E-119E	31N-34N	25
5.Darwin	129E-133E	14S-10S	20
6.Manus	146E-149E	4S-1S	12
7.Nauru	166E-169E	2S-1N	15
8.SHEBA	190E-220E	74N-78N	125
9.MAGIC1	201E-214E	16N-25N	121
10.MAGIC2	207E-232E	24N-30N	147
11.MAGIC3	221E-243E	29N-36N	162
12.NSA	202E-206E	70N-73N	16
13.CARE	238E-240E	37N-39N	9
14.SGP	261E-264E	35N-38N	12
15.Vocals	272E-291E	23S-17S	112
16.Amazonia	296E-301E	13S-9S	25
17.Manaus	298E-302E	5S-1S	25
18.Azores-Graciosa	329E-334E	38N-41N	20
19.Barbados	291E-301E	10N-20N	108

#CAM h4 (cam2.h4) : Global 3D 3hrly (instantaneous values for all output)

CLDICE	30	kg/kg	Grid box averaged cloud ice amount
CLDLIQ	30	kg/kg	Grid box averaged cloud liquid amount
CLOUD	30	fraction	Cloud fraction
CONCLD	30	fraction	Convective cloud cover
OMEGA	30	Pa/s	Vertical velocity (pressure)
PS	1	Pa	Surface pressure
Q	30	kg/kg	Specific humidity
RELHUM	30	percent	Relative humidity
T	30	K	Temperature
U	30	m/s	Zonal wind
V	30	m/s	Meridional wind
Z3	30	m	Geopotential Height (above sea level)

#CAM h5 (cam2.h5) : Global 2D 3hrly mean

CAPE	1	J/kg	Convectively available potential energy
CIN	1	J/kg	Convective inhibition
CLDHGH	1	fraction	Vertically-integrated high cloud
CLDLow	1	fraction	Vertically-integrated low cloud
CLDMED	1	fraction	Vertically-integrated mid-level cloud
CLDTOT	1	fraction	Vertically-integrated total cloud
FLDS	1	W/m2	Downwelling longwave flux at surface
FLDSC	1	W/m2	Clearsky Downwelling longwave flux at surface
FLNS	1	W/m2	Net longwave flux at surface
FLNSC	1	W/m2	Clearsky net longwave flux at surface
FLNT	1	W/m2	Net longwave flux at top of model
FLNTC	1	W/m2	Clearsky net longwave flux at top of model
FLUT	1	W/m2	Upwelling longwave flux at top of model
FLUTC	1	W/m2	Clearsky upwelling longwave flux at top of model
FSDS	1	W/m2	Downwelling solar flux at surface
FSDSC	1	W/m2	Clearsky downwelling solar flux at surface
FSNS	1	W/m2	Net solar flux at surface
FSNSC	1	W/m2	Clearsky net solar flux at surface
FSNT	1	W/m2	Net solar flux at top of model
FSNTC	1	W/m2	Clearsky net solar flux at top of model
FSNTOA	1	W/m2	net solar flux at top of atmosphere
FSNTOAC	1	W/m2	Clearsky net solar flux at top of atmosphere
ICEFRAC	1	fraction	Fraction of sfc area covered by sea-ice
LHFLX	1	W/m2	Surface latent heat flux
LWCF	1	W/m2	Longwave cloud forcing
OMEGA500	1	Pa/s	Vertical velocity at 500 mbar pressure surface
OMEGA850	1	Pa/s	Vertical velocity at 850 mbar pressure surface
PBLH	1	m	PBL height
PRECC	1	m/s	Convective precipitation rate (liq + ice)
PRECCDZM	1	m/s	Convective precipitation rate from ZM deep
PRECL	1	m/s	Large-scale (stable) precipitation rate (liq + ice)
PRECSC	1	m/s	Convective snow rate (water equivalent)
PRECSH	1	m/s	Shallow Convection precipitation rate
PRECSL	1	m/s	Large-scale (stable) snow rate (water equivalent)
PRECT	1	m/s	Total precipitation rate (liq + ice) (instantaneous value)
PS	1	Pa	Surface pressure
PSL	1	Pa	Sea level pressure

Q200	1	kg/kg	Specific Humidity at 700 mbar pressure surface
Q850	1	kg/kg	Specific Humidity at 850 mbar pressure surface
QREFHT	1	kg/kg	Reference height humidity
RHREFHT	1	fraction	Reference height relative humidity
SHFLX	1	W/m2	Surface sensible heat flux
SOLIN	1	W/m2	Solar insolation
SWCF	1	W/m2	Shortwave cloud forcing
T300	1	K	Temperature at 300 mbar pressure surface
T850	1	K	Temperature at 850 mbar pressure surface
TAUX	1	N/m2	Zonal surface stress
TAUY	1	N/m2	Meridional surface stress
TGCLDCWP	1	kg/m2	Total grid-box cloud water path (liquid and ice)
TGCLDIWP	1	kg/m2	Total grid-box cloud ice water path
TGCLDLWP	1	kg/m2	Total grid-box cloud liquid water path
TMQ	1	kg/m2	Total (vertically integrated) precipitable water
TREFHT	1	K	Reference height temperature
TS	1	K	Surface temperature (radiative)
U200	1	m/s	Zonal wind at 200 mbar pressure surface
U850	1	m/s	Zonal wind at 850 mbar pressure surface
UBOT	1	m/s	Lowest model level zonal wind
V200	1	m/s	Meridional wind at 200 mbar pressure surface
V850	1	m/s	Meridional wind at 850 mbar pressure surface
VBOT	1	m/s	Lowest model level meridional wind
Z500	1	m	Geopotential Z at 500 mbar pressure surface

Note: PRECT (total precipitation rate) is output as instantaneous value. To get the accumulated total precipitation, add PRECC and PRECL together.

#CLM h0: global 2D 0.5hr/time step

FCEV	1	watt/m^2	canopy evaporation
FCTR	1	watt/m^2	canopy transpiration
FGEV	1	watt/m^2	ground evaporation
FGR	1	watt/m^2	heat flux into soil/snow including snow melt
FIRA	1	watt/m^2	net infrared (longwave) radiation
FIRE	1	watt/m^2	emitted infrared (longwave) radiation
FSA	1	watt/m^2	absorbed solar radiation
FSH	1	watt/m^2	sensible heat
FSH_G	1	watt/m^2	sensible heat from ground
FSH_V	1	watt/m^2	sensible heat from veg
FSNO	1	watt/m^2	fraction of ground covered by snow
FSR	1	watt/m^2	reflected solar radiation
QDRAI	1	mm/s	sub-surface drainage
QDRIP	1	mm/s	throughfall
QINFL	1	mm/s	infiltration
QMELT	1	mm/s	snow melt
QOVER	1	mm/s	surface runoff
QSOIL	1	mm/s	ground evaporation
QVEGE	1	mm/s	canopy evaporation
QVEGT	1	mmm/s	canopy transpiration
RAIN	1	mm/s	atmospheric rain
SNOW	1	mm/s	atmospheric snow
SOILWATER_10CM	1	kg/m2	soil liquid water + ice in top 10cm of soil
TLAI	1	none	leaf area index
TSOI_10CM	1	K	soil temperature in top 10cm of soil
WA	1	mm	water in the unconfined aquifer
ZWT	1	m	water table depth

#CLM h1: global 3D 3hr (all instantaneous values)

SOILLIQ	15	kg/m2	soil liquid water
SOILICE	15	kg/m2	soil ice
TSOI	15	K	soil temperature